REMARKS

Claims 1 and 31 have been amended. Claims 1-3, 6-14, 16, 18, 21-29, 31 and 36-45 remain pending. Applicants reserve the right to pursue the original claims and other claims in this and other applications. Applicants respectfully request reconsideration of the above-referenced application in light of the amendments and following remarks.

Claims 1-3, 6-14, 16, 18, 21-29, 31 and 36-45 stand rejected under 35 U.S.C. § 103(a) as being unpatentable over Wang et al. (U.S. Patent No. 6,376,309) ("Wang") in view of Hoff et al., "Atomic Oxygen and the Thermal Oxidation of Silicon" ("Hoff"), or Ruzyllo et al., "Evaluation of Thin Oxides Grown by the Atomic Oxygen Afterglow Method" ("Ruzyllo"). The rejection is respectfully traversed.

Claim 1, as amended, recites a method comprising, *inter alia,* the acts of "forming a tunnel oxide ... forming a first conductor layer ... forming an insulating layer ... said insulating layer further comprising the steps of: forming a first oxide layer ... forming a nitride layer ... and forming a second oxide layer ... in a single processing step ... at a temperature of about 850°C to about 1100°C, for about 1 second to about 10 minutes, with a gas ambient containing atomic oxygen, wherein said second oxide layer formed by the single processing step results in a deposited thickness of at least 60% of a targeted thickness of the second oxide layer, and wherein said targeted thickness is from about 20 Å to about 80 Å thick; [and] after said single processing step, forming a second conductor layer over said insulating layer."

Claim 16 recites a method comprising, *inter alia,* the acts of "depositing a first oxide layer ... depositing a nitride layer ... and forming a second oxide layer ... in a single processing step ... using a gas ambient containing atomic oxygen, wherein ... the second oxide layer formed by the single processing step has a deposited thickness of at

least 60% of a targeted thickness of the second oxide layer, and wherein said targeted thickness is from about 20 Å to about 80 Å thick."

Similarly, claim 31 recites a method comprising the acts of "forming a tunnel oxide ... forming a first conductor layer ... forming an insulating layer ... further comprising the steps of: forming a first oxide layer ... forming a nitride layer ... and forming a second oxide layer in a single processing step ... grown in the presence of atomic oxygen at a temperature of about 850°C to about 900°C for a period of about 1 second to 10 minutes, and wherein said second oxide layer is formed by the single processing step to be deposited with a thickness of at least about 60% of a targeted thickness of said second oxide layer, wherein said targeted thickness is from about 20 Å to about 80 Å thick, and said second oxide layer is deposited to be from about 12 Å to 48 Å thick; [and] after said single processing step, forming a second conductor layer over said insulating layer."

The cited combination does not disclose, teach, or suggest all of the limitations of the above claims. More specifically, the cited combination does not disclose a second oxide layer being formed using a gas ambient containing atomic oxygen in a single processing step, at a temperature from about 850°C to about 1100°C, in a time frame of about 1 second to about 10 minutes, resulting in a deposited thickness of at least 60% of a targeted thickness, the targeted thickness being about 20 Å to about 80 Å thick.

The Office Action acknowledges that "Wang et al. fails to show forming the second oxide layer using an oxidizing ambient in atomic oxygen to form the oxide layer with a thickness of 60% of a targeted thickness and at various temperatures and times." (Office Action, p. 3). The Office Action relies upon Hoff or Ruzyllo for disclosing the act of forming the second oxide layer by means of an oxidizing ambient using atomic

oxygen. Even if the references were properly combinable, which they are not, as discussed below, Hoff and Ruzyllo do not disclose the method of forming the oxide layer claimed in the invention.

As indicated above, the invention's top oxide layer is formed with a single processing step. The Office Action asserts that Hoff or Ruzyllo disclose a single process step. However, in order to render the current invention obvious, the references must also disclose or suggest all other aspects of the claims, which they do not.

The Hoff and Ruzyllo references do not disclose Applicants' claimed temperature range "of about 850°C to about 1100°C," as recited in claims 1 and 16, or "about 850°C to about 900°C," as recited in claim 31. Instead, they disclose an oxidation temperature of around 400°C (to a maximum of 850°C). Ruzyllo's 400°C is significantly less than Applicants' claimed temperature range for forming the second oxide layer in an ONO stack. Therefore, the references do not suggest the process using atomic oxygen at a temperature of about 850°C to about 1100°C.

The Hoff and Ruzyllo references also do not disclose an oxidation time of "about 1 second to about 10 minutes" as recited in claims 1, 16 and 31. In fact, these references disclose a much longer "5 minute to 2 hour" time period for the oxidation process. The shorter oxidation time, as claimed, would not have been obvious from the cited references.

Finally, the Hoff and Ruzyllo references do not disclose "a deposited thickness of at least 60% of a targeted thickness, the targeted thickness being about 20 Å to about 80 Å thick" as recited in claims 1, 16, and 31. The Office Action further asserts that "the claim [1, 16, and 31] fails to describe how the targeted thickness is determined, so if one knows that the thickness of an oxide will be 60% of a targeted thickness then

the examiner fails to see why the targeted thickness could not be 60% of the first targeted thickness when giving the claim its broadest interpretation." (Office Action, p. 4). Applicants respectfully submit, however, that the targeted thickness is given a definite parameter in the claims. At least 60% of between 20 Å to about 80 Å of a second or top oxide layer will be grown in a single process step by applying Applicants' claimed methods. This oxide layer is not disclosed or suggested by the references.

The Office Action also asserts that "[w]ith respect to the particular time and temperature of the oxidation, it would have been obvious to determine through routine experimentation the optimum time and temperature to conduct the oxidation process based upon a variety of factors including the desired thermal budget and would not lend patentability to the instant application absent the showing of unexpected results." (Office Action, p. 4).

Applicants respectfully submit, however, that the Office Action fails to set forth a *prima facie* case of obviousness. *See* M.P.E.P. § 2142. In particular, none of the cited references, alone or in combination, teaches or suggests Applicants' claimed time and temperature combination for growing a top oxide layer of the claimed thickness, in a single process step. "To establish *prima facie* obviousness of a claimed invention, all the claim limitations must be taught or suggested by the prior art." M.P.E.P. § 2143.03. It is inappropriate to merely conclude that these parameters can be determined through routine optimization.

The cited references do not teach or suggest at least a second oxide layer being formed using a gas ambient containing atomic oxygen in a single processing step, at a temperature from about 850°C to about 1100°C (or about 850°C to about 900°C), in a time frame of about 1 second to about 10 minutes, resulting in a deposited thickness

of at least 60% of a targeted thickness, the targeted thickness being about 20 Å to about 80 Å thick. As previously discussed, this combination of limitations is not disclosed or suggested within the cited references.

Further, the motivation to combine the references is lacking. The Office Action asserts that the processes in Hoff and Ruzyllo would allow for oxide growth, in Wang, at low temperatures with high breakdown values; and thus, motivation is provided for combining either reference with Wang. Applicants respectfully disagree.

Employing atomic oxygen, in Wang, would increase the gate aspect ratio which directly contradicts the purpose of Wang. The idea of forming a thicker ONO structure is completely contrary to the problem that Wang is directed to solving: reducing the gate aspect ratio of a flash memory device. For example, in Hoff, films that were grown in the afterglow method using atomic oxygen at a high temperature, were overall thicker than those grown in the thermal mode alone (p. 2, ¶2). A thicker ONO structure increases the gate aspect ratio and thus, an atomic oxygen process would not be desirable in Wang. Accordingly, one skilled in the art would not be motivated to combine Hoff or Ruzyllo's atomic oxygen process with Wang since it would increase the gate aspect ratio rather than decrease it; thereby, completely contradicting Wang's teachings.

Additionally, even if it were desired to form a thicker oxide layer in Wang, one skilled in the art would not have been motivated to look to Hoff for the solution. Hoff states that the data sets for afterglow (atomic oxygen) versus atmospheric oxygen converge at temperatures greater than 700°C; the additional thickness benefits of Hoff are no longer readily apparent at temperatures over 700°C (such as at the high temperatures of the Wang process). Therefore, it would not have occurred to one skilled in the art to use the atomic oxygen process of Hoff for forming the second oxide

layer of Wang.

Moreover, even if the references could somehow be combined, despite any motivation to do so, it is well-settled that "[t]he mere fact that references can be combined or modified does not render the resultant combination obvious unless the prior art also suggests the desirability of the combination." M.P.E.P. § 2143.01.

The prior art is not suggesting the proposed combination; but, rather the claimed invention is the foundation for the combination. As noted above, the references teach away from each other since using atomic oxygen in Wang would increase the gate aspect ratio which is completely contrary to the problem that Wang is directed to solving: reducing the gate aspect ratio. The proposed combination is improper hindsight reconstruction.

This fact is underscored by M.P.E.P. § 2143.02, which indicates that "[a] statement that modifications of the prior art to meet the claimed invention would have been 'well within the ordinary skill of the art' at the time the claimed invention was made because the references relied upon teach that all aspects of the claimed invention were individually known in the art is not sufficient to establish a *prima facie* case of obviousness without some objective reason to combine the teachings of the references."

The Office Action states that "the upper oxide layer in Wang is being replaced by the oxide layer as shown in Huff or Ruzyllo and therefore any reference to the top oxide layer in Wang is improper." (Office Action, p. 5). Again, Applicants respectfully submit that there must be some motivation to substitute Wang's top oxide layer with another oxide layer. In this case, there is none. Wang relates to reducing the gate aspect ratio of a gate stack structure. Employing Huff or Ruzyllo's oxide layer would still yield a thicker gate stack structure which would increase the gate aspect

ratio in Wang: completely defeating the very purpose of Wang. There simply is no objective reasoning to combine Wang with Hoff or Ruzyllo where the proposed combination would increase the gate aspect ratio in Wang.

Claims 2-3 and 6-14 depend from claim 1, claims 18 and 21-29 depend from claim 16, and claims 36-45 depend from claim 31. These dependent claims should be allowable for at least the reasons set forth above regarding their independent base claims.

In view of the above, each of the presently pending claims in this application is believed to be in immediate condition for allowance. Accordingly, the Examiner is respectfully requested to review and to pass this application to issue.

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Respectfully submitted,

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